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LARVAL DESCRIPTION OF *RIVELLIA PALLIDA* (DIPTERA: PLATYSTOMATIDAE), A CONSUMER OF THE NITROGEN-FIXING ROOT NODULES OF HOG-PEANUT, *AMPHICARPA BRACTEATA* (LEGUMINOSAE)

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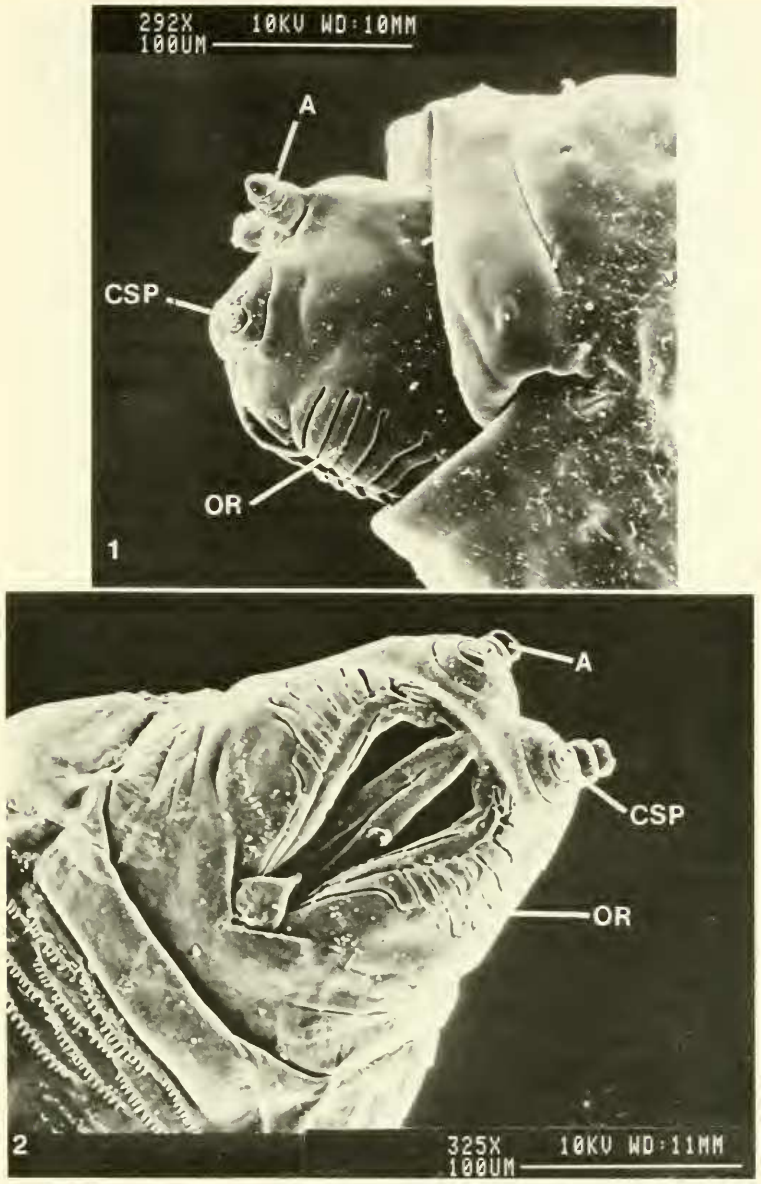
Abstract.—The mature larva of *Rivellia pallida* Loew, a consumer of the nitrogen-fixing root nodules of hog-peanut, is described and illustrated utilizing a scanning electron microscope. A morphological comparison of four species of *Rivellia* indicates that the number of papillae bordering the anterior spiracles is of some value in distinguishing among species.

Surprisingly little biological information is available for the numerous species of acalyptrate Diptera belonging to the largely tropical family Platystomatidae. Larvae of a few species of the genus *Rivellia* are known to feed on the nitrogen-fixing root nodules of legumes (Foote, 1985), and it appears that certain of these species have shifted to agriculturally important species of Leguminosae (Diatloff, 1965; Koizumi, 1957; Seeger and Maldague, 1960) in other regions of the world. Recently, Eastman and Wuensche (1977) have elucidated the life cycle and briefly described the immature stages of *Rivellia quadrifasciata* (Macquart), a Nearctic species which is acquiring some significance as a pest of soybean, *Glycine max* L. (Newsom et al., 1978) and southern pea, *Vigna unguiculata* (L.) Walp. (Koethe and Van Duyn, 1984) in southeastern United States. Because of the probability that additional species of *Rivellia* will shift to introduced, economically significant legumes, it is important that the larval morphology and basic biology of the native North American species be described. This paper supplements the publication by Foote (1985) that presented life history data and described the larval feeding habits of *Rivellia pallida* Loew, a common and widespread woodland species that attacks the nitrogen-fixing root nodules of hog-peanut, *Amphicarpa bracteata* (L.) Fernald. Here, we utilize a scanning electron microscope to describe the mature larva of that species.

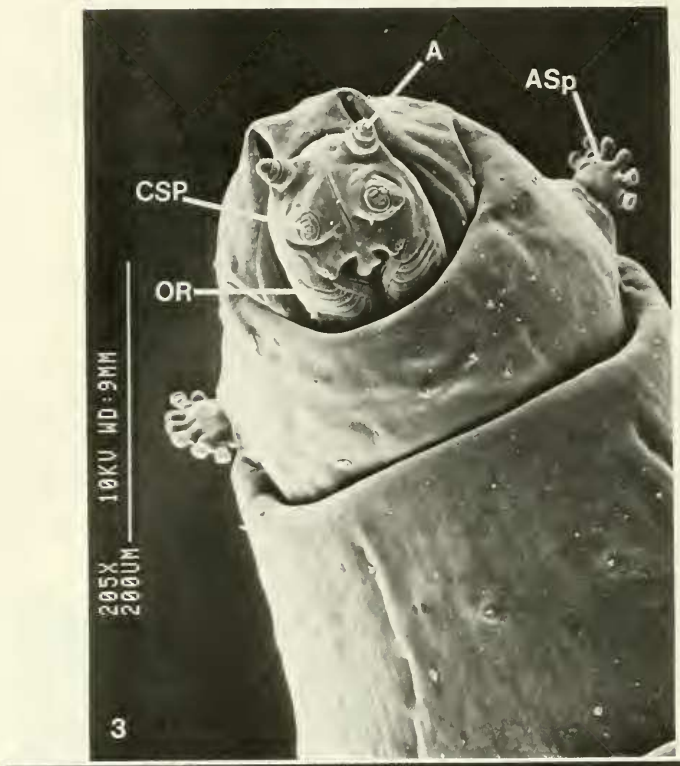
Materials and Methods

Mature larvae were obtained from soil below stands of hog-peanut occurring in wooded habitats near the city of Kent in Portage County, Ohio. They were prepared for scanning by subjecting them to critical point desiccation, using the method of Grodowitz et al. (1982) as a guide. Larvae were killed in boiling water, placed in Supper Skipper for 30 to 60 seconds, and then transferred to Carl's Solution where they were left for approximately 24 hours. Specimens were then dehydrated in a standard ethanol series. Following these initial preparations,

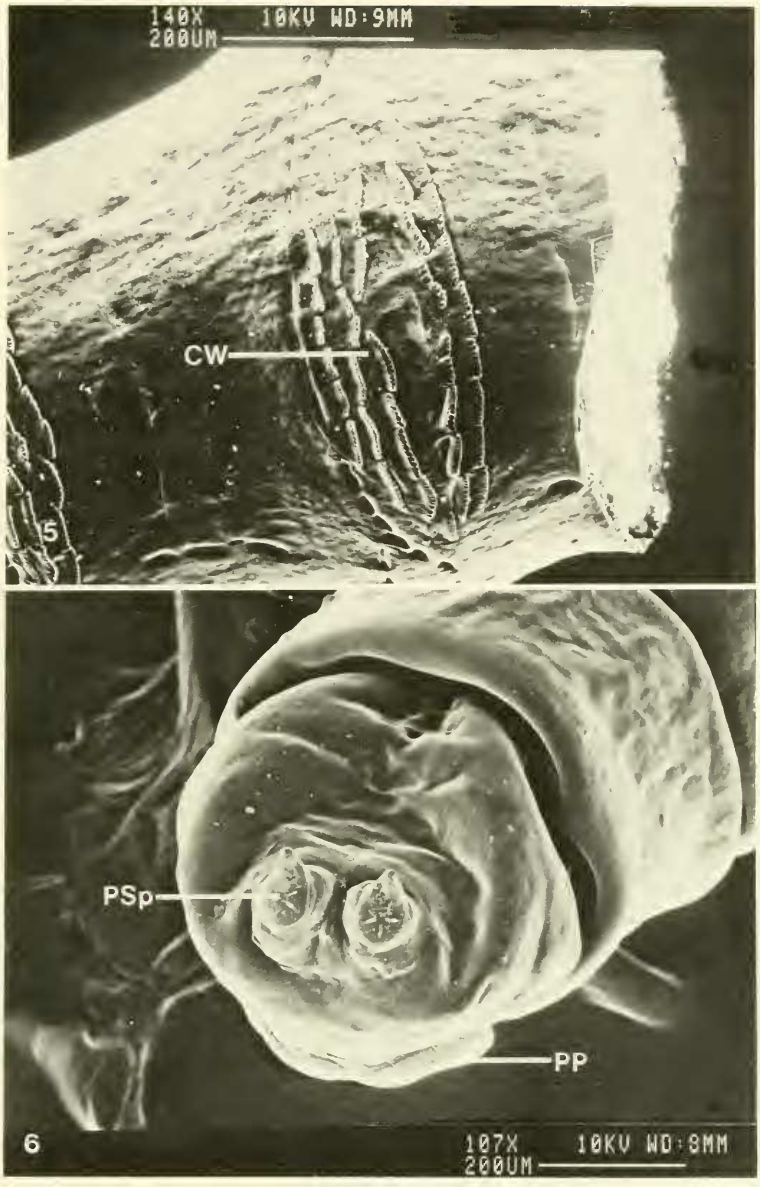


Figs. 1, 2. *Rivellia pallida*. 1, Lateral view of cephalic segment. 2, Facial mask. (A, antenna; CSP, circular sensory plate; OR, oral ridge.)

larvae were cut in desired ways so that they could be easily mounted after critical point desiccation was completed. We used the Polaron Critical Point Drying Apparatus, with ethanol as the transfer liquid and CO_2 as the transition liquid. Specimens were sputter coated with gold/palladium to a thickness of about 400 nm. Coated larvae were then examined with a Cambridge Stereoscan 100 Electron Microscope. Photographs were obtained with a high resolution camera and Polaroid (#52) film.

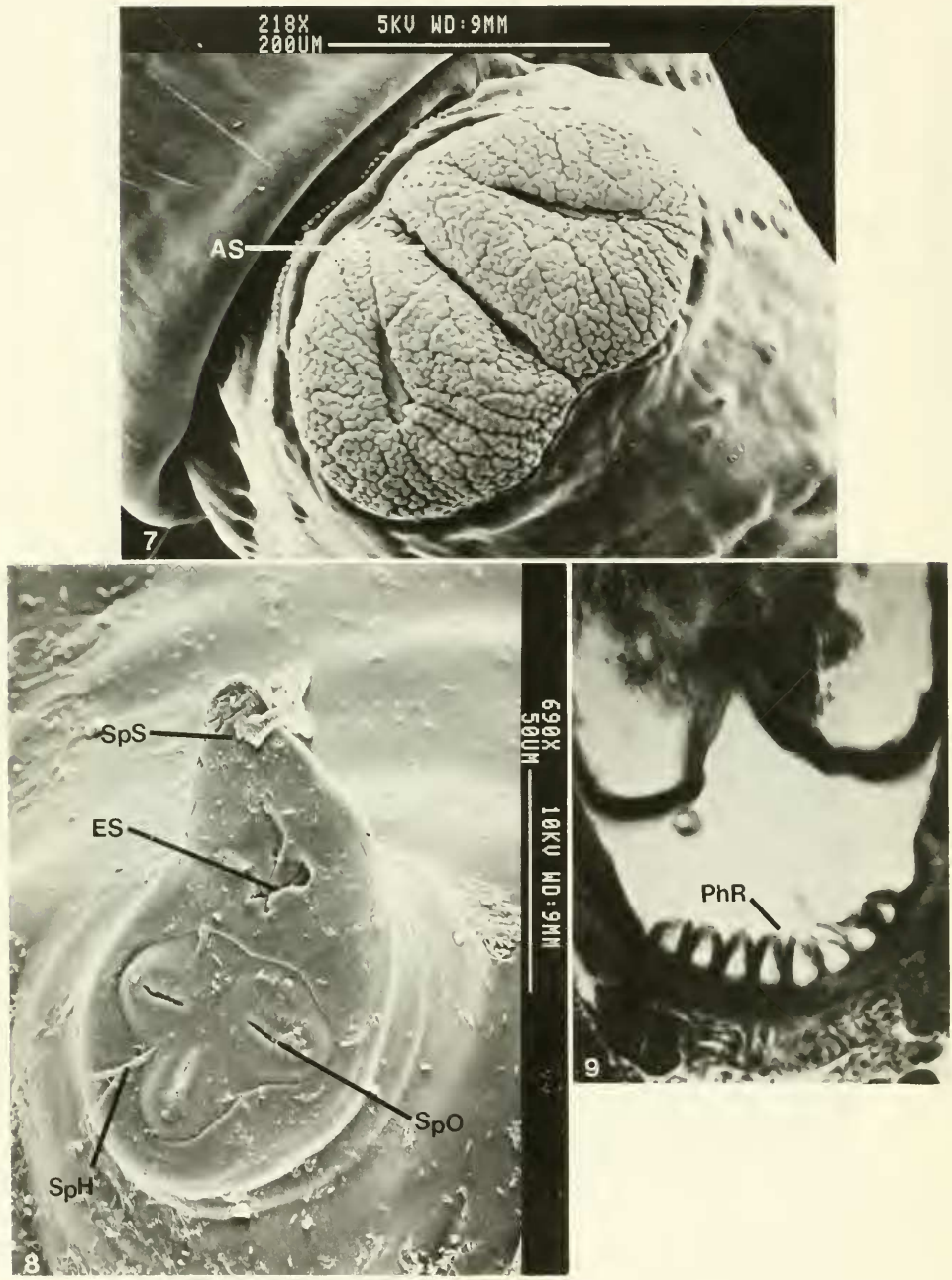


Figs. 3, 4. *Rivellia pallida*. 3, Ventral view of anterior end. 4, Anterior spiracle. (A, antenna; ASp, anterior spiracle; CSP, circular sensory plate; OR, oral ridge; Pa, papilla.)



Figs. 5, 6. *Rivellia pallida*. 5, Ventral view of fifth abdominal segment. 6, Posterior view of caudal segment. (CW, creeping welt; PP, perianal pad; PSp, posterior spiracle.)

In the examination of the *Rivellia* larval anatomy, certain surface structures of interest were studied. These included the facial mask, anterior and posterior spiracles, perianal pad, and ventral creeping welts. The cephalopharyngeal skeleton and its component sclerites were examined by light microscopy. The skeleton was dissected from the mature larva, macerated in a 10% KOH solution, and mounted in glycerol for microscopic examination.



Figs. 7–9. *Rivellia pallida*. 7, Perianal pad. 8, Posterior spiracle. 9, Cross-sectional view of filtering mechanism in floor of tentoropharyngeal sclerite. (AS, anal slit; ES, ecdysial scar; PhR, pharyngeal ridge; SpH, spiracular hair; SpO, spiracular opening; SpS, spiracular spine.)

Description of Mature Larva of *Rivellia pallida*

Length 5.0–8.0 mm; muscidiform, with anterior end tapering and caudal segment bluntly rounded. Integument smooth, without setae or segment-encircling spinule bands, creeping welts present ventrally. Whitish to pale yellow.

Cephalic segment (Fig. 1) retractile and bearing 2 pairs of sensory organs, 2-segmented, elongated antennae apically and circular sensory plates apicoventrally. Facial mask (Fig. 2) with 7 broad oral ridges and 8 narrow grooves leading into preoral cavity, cavity appearing to be divided by median rod and bearing triangular fleshy projection posteriorly.

Cephalopharyngeal skeleton deeply pigmented; tentoropharyngeal and hypopharyngeal sclerites separate. Dorsal cornua of tentoropharyngeal sclerite slender, connected anteriorly by narrow, weakly pigmented, somewhat fenestrated dorsal bridge; ventral cornua with small lobe dorsobasally, without windows distally; pharyngeal filtering mechanism present in floor of sclerite (Fig. 9). Hypopharyngeal sclerite H-shaped with single broad, weakly pigmented transverse bridge; parastomal bars short, rod-like, and free apically. No well-defined epipharyngeal or labial sclerites. Mandibles deeply pigmented; hook part weakly decurved, bluntly rounded apically, and lacking accessory teeth along ventral margin; basal part subrectangular, without windows; dental sclerites absent or vestigial; no accessory oral sclerites.

Thoracic segments cylindrical, without encircling spinule bands; metathorax ventrally with weakly developed creeping welt of pale spinules near posterior border of segment. Anterior spiracles borne posterolaterally on prothorax (Fig. 3); spiracles (Fig. 4) fan-shaped with 6–7 blunt papillae arranged in single row along distal margin. Abdominal segments all very similar, cylindrical, without encircling spinule bands; each segment ventrally with weak creeping welt (Fig. 5) composed of 4–5 rows of blunt-tipped, posteriorly directed spinules. Caudal segment (Fig. 6) truncate to bluntly rounded, without fleshy protuberances laterally; perianal pad (Fig. 7) bilobed, each lobe somewhat hemispherical in shape, fleshy, and reticulate, without noticeable spinule patches, but with single spinule row posterior to pad.

Posterior spiracular disc (Fig. 6) without tubercles. Posterior spiracles borne on upper half of disc, distinctly separated, and somewhat elevated on deeply pigmented bases. Each spiracular plate (Fig. 8) with dorsally or dorsolaterally projecting spine on upper surface and 3 oval to elongate-oval spiracular openings arranged ray-like around ecdysial scar, openings nearly at right angles to each other; spiracular hairs vestigial or absent.

Discussion

Unfortunately, there appears to be relatively little morphological variation among larvae of different species of *Rivellia*. Larvae of four species were examined: *R. pallida, R. steyskali* Namba from tick trefoil (*Desmodium paniculatum* (L.) DC.), *R. viridulans* Robineau-Desvoidy from black locust (*Robinia pseudo-acacia* L.), and *R. winifredae* Namba, from groundnut (*Apios americana* Medic.). The only character that varied among the four species was the number of papillae on the distal margin of the anterior spiracles. *Rivellia pallida* and *viridulans* both possessed 6–7 papillae; *steyskali,* 7–9; and *winifredae,* 9–10. Because the number of

papillae overlapped among the four taxa, the number alone is not sufficient to distinguish species. Obviously, a much more extensive study of the larval morphology of the Nearctic species must be made before a meaningful key to the larvae can be composed.

Acknowledgments

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